

**CALIFORNIA ENERGY COMMISSION**1516 Ninth Street  
Sacramento, California 95814Main website: [www.energy.ca.gov](http://www.energy.ca.gov)

**NOTIFICATION OF APPROVAL  
OF STANDARD U-FACTOR DATA FOR  
SPANDREL PANELS AND GLASS CURTAIN WALLS**

As part of the adoption of the 2005 Building Energy Efficiency Standards, the California Energy Commission adopted Joint Appendix IV, which contains standard U-factor, C-factor and Thermal Mass data for roof, wall and floor construction assemblies (see page IV-1 of the Joint Appendices at:

[http://www.energy.ca.gov/title24/2005standards/2004-10-06\\_400-03-001-JAF.PDF](http://www.energy.ca.gov/title24/2005standards/2004-10-06_400-03-001-JAF.PDF)).

The data in Joint Appendix IV must be used for all residential and nonresidential compliance approaches, including the mandatory requirements, prescriptive envelope component approach, prescriptive overall envelope approach and performance approach for nonresidential, high-rise residential and hotel/motel buildings, and the mandatory requirements, prescriptive and performance approaches for low-rise residential buildings.

If a construction assembly is not adequately represented in Joint Appendix IV, an applicant may request approval by the Energy Commission's Executive Director for different data for that construction assembly. The approval of the Executive Director is based on the technical justification submitted by the applicant. Approved standard data for the construction assembly will be published as an addendum to Joint Appendix IV for use in all compliance approaches.

This Notice of Approval of Standard U-factor data for Spandrel Panels and Glass Curtain Walls in Low-Rise Residential Buildings and for Type V Nonresidential Buildings authorizes the use of the data shown in the attached revised Table IV.15a which officially replaces Table IV.15 in Joint Appendix IV.

Approved by:

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B. B. BLEVINS  
Executive Director

Dated

1-4-06



**Table IV.15a – U-factors for Spandrel Panels and Glass Curtain Walls**

Frame Type	Spandrel Panel		Rated R-value of Insulation between Framing Members							
			None	R-4	R-7	R-10	R-15	R-20	R-25	R-30
			A	B	C	D	E	F	G	H
Aluminum without Thermal Break	Single glass pane, stone, or metal panel	1	0.361	0.248	0.229	0.219	0.210	0.206	0.203	0.201
	Double glass with no low-e coatings	2	0.301	0.239	0.224	0.216	0.209	0.205	0.202	0.200
	Triple or low-e glass	3	0.269	0.231	0.220	0.214	0.208	0.204	0.202	0.200
Aluminum with Thermal Break	Single glass pane, stone, or metal panel	4	0.351	0.215	0.191	0.179	0.168	0.161	0.158	0.155
	Double glass with no low-e coatings	5	0.280	0.204	0.186	0.175	0.166	0.160	0.157	0.154
	Triple or low-e glass	6	0.242	0.195	0.181	0.172	0.164	0.159	0.156	0.154
Structural Glazing	Single glass pane, stone, or metal panel	7	0.350	0.195	0.165	0.149	0.135	0.127	0.122	0.119
	Double glass with no low-e coatings	8	0.272	0.181	0.158	0.145	0.133	0.126	0.121	0.118
	Triple or low-e glass	9	0.227	0.169	0.152	0.141	0.131	0.124	0.120	0.117
No framing or Insulation is Continuous	Single glass pane, stone, or metal panel	10	0.361	0.148	0.102	0.078	0.056	0.044	0.036	0.031
	Double glass with no low-e coatings	11	0.301	0.137	0.097	0.075	0.055	0.043	0.035	0.030
	Triple or low-e glass	12	0.269	0.130	0.039	0.073	0.053	0.042	0.035	0.030

This table has U-factors for the spandrel section of glass and other curtain wall systems. Design factors that affect performance are the type of framing, the type of spandrel panel and the R-value of insulation.

Four framing conditions are considered in the table. The first is the common case where standard aluminum mullions are used. Standard mullions provide a thermal bridge through the insulation, reducing its effectiveness. The second case is for metal framing members that have a thermal break. A thermal break frame uses a urethane or other non-metallic element to separate the metal exposed to outside conditions from the metal that is exposed to interior conditions. The third case is for structural glazing or systems where there is no exposed mullion on the interior. The fourth case is for the condition where there is no framing or the insulation is continuous and uninterrupted between framing. The columns in the table can be used for any specified level of insulation between framing members installed in framed curtain walls or spandrel panels.



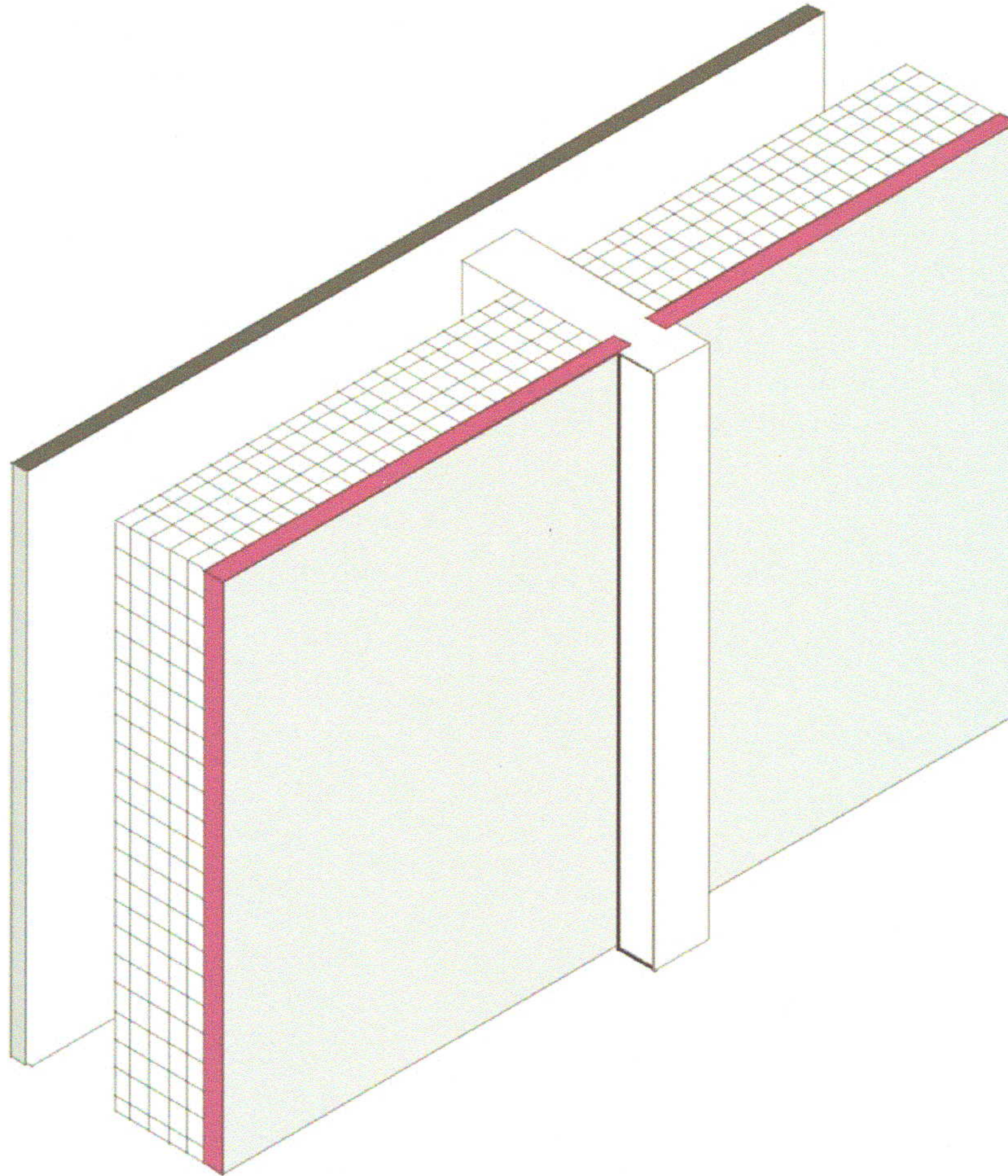


Figure IV.15a – Spandrel Panel

There are three spandrel panel cases considered in the table. The first is for a panel that provides little or no insulating value. This includes single pane glass, stone veneer, metal panels, or pre-cast concrete less than 2 inch. thick. The second case is for insulating glass. Sometimes insulating glass is used so that the spandrel panel looks similar to the vision glass. The third case is for triple glass or double glass that has a low-e coating.

Insulation levels are shown in the columns of the table. When the table is used manually, the R-value of insulation shall be equal to or greater than the R-value published in the columns. No interpolation is permitted when data from the table is selected manually. California Energy Commission approved Alternative Calculation Methods, including those used for prescriptive compliance, may accurately account for any amount of continuous insulation or for unusual construction assemblies using Equation IV-1 and Equation IV-2. If the curtain wall has an insulated metal-framed wall on the inside, then values from this table may be combined with values from Table IV.11 or Table IV.19 using the procedures of Equation IV-2 or Equation IV-3.

**Assumptions.** The U-factors in Table IV.15 were derived from a regression analysis of the values for “Glass Only Center of Glass” and “Curtain Wall” in the ASHRAE 2001 Fundamentals Handbook, Chapter 30, Table 4. The U-factors in Table IV.15 include an exterior air film with an R-value of 0.17 and an interior air film R-value of 0.68, which are accounted for in the values from the ASHRAE 2001 Fundamentals. The construction assembly consists of the Frame Type and Spandrel Panel combinations listed in Table IV.15, an air gap with an R-value of 1.39 (3/4 inch gap, 50 °F mean temperature and 30 °F temperature difference), and 5/8 inch. gypsum board with an R-value of 0.56 that provides the interior finish. The gypsum board is assumed to span between the window sill and a channel at the floor.



The following equations were used when no rigid insulation is added to the assembly.

Aluminum Without Thermal Break:

$$U_{\text{Overall}} = 1 / ((R_{\text{Gypsum}} + R_{\text{Air Gap}}) + (1 / (0.3007 + 0.8882 \times U_{\text{Center of Glass}})))$$

Aluminum With Thermal Break:

$$U_{\text{Overall}} = 1 / ((R_{\text{Gypsum}} + R_{\text{Air Gap}}) + (1 / (0.1936 + 0.8814 \times U_{\text{Center of Glass}})))$$

Structural Glazing:

$$U_{\text{Overall}} = 1 / ((R_{\text{Gypsum}} + R_{\text{Air Gap}}) + (1 / (0.1238 + 0.9448 \times U_{\text{Center of Glass}})))$$

The following equations were used when rigid insulation is added to the assembly.

Aluminum Without Thermal Break:

$$U_{\text{Overall}} = 1 / ((R_{\text{Gypsum}} + R_{\text{Air Gap}}) + (1 / (0.3007 + 0.8882 \times ((1/R_{\text{Added Insulation}}) + U_{\text{Center of Glass}}))))$$

Aluminum With Thermal Break:

$$U_{\text{Overall}} = 1 / ((R_{\text{Gypsum}} + R_{\text{Air Gap}}) + (1 / (0.1936 + 0.8814 \times ((1/R_{\text{Added Insulation}}) + U_{\text{Center of Glass}}))))$$

Structural Glazing:

$$U_{\text{Overall}} = 1 / ((R_{\text{Gypsum}} + R_{\text{Air Gap}}) + (1 / (0.1238 + 0.9448 \times ((1/R_{\text{Added Insulation}}) + U_{\text{Center of Glass}}))))$$